B.10. ENHANCING THE EFFICIENCY OF THE DEHYDRATION PROCESS IN SYSTEMS POWERED BY RENEWABLE ENERGY SOURCES

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Abstract. This study addresses the optimization of dehydration processes for fruits and vegetables using installations integrated with renewable energy sources (RES). Given the high energy sensitivity of food preservation, the research aims to minimize thermal losses and maximize the use of solar and biomass energy. To achieve these objectives, a multi-disciplinary modeling approach was adopted. The mechanical components and the airflow dynamics within the drying chamber were designed and visualized using SolidWorks, ensuring an optimal structural configuration for uniform heat distribution. Furthermore, the thermodynamic behavior of the system and the kinetics of water removal were modeled in MATLAB, allowing for the precise determination of drying curves. To validate the experimental results, thermal and fluid-flow simulations were performed in ANSYS, identifying areas of thermal stagnation and optimizing the convective heat transfer coefficient. The results indicate that the integration of these digital twins into the design phase allows for an increase in energy efficiency of approximately 18-22% and a significant reduction in drying time. This integrated approach proves that combining renewable energy with advanced numerical simulation is essential for modern, sustainable, and high-quality food processing.
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Keywords: food dehydration, solar drying systems, solidworks design, Matlab modeling, ansys fluid simulation, renewable energy integration, energy efficiency.